

deposition rates are handled sensitively for a New South Wales basin by Srikanthan and Wasson (Section 3). They suggest that post-1950 declines in sedimentation rate reflected equilibration of the upstream drainage network following incision soon after European settlement. 'Recent changes' is a theme which will be returned to in the IAHS ICCE volumes for Canberra (December 1994) and Exeter (July 1996). Through a combination of SHE model simulations and simultaneous measurements of sediment transport and hillslope erosion rates in the Syv Brook catchment, Denmark, Hasholt and Styczen (Section 4) demonstrate the significance of groundwater levels in the relative dominance of soil erosion components. In the same section, Ritchie *et al.* present a useful-looking airborne laser technique with a vertical accuracy of 0.05 m for the rapid surveying of channel cross-sections. A detailed investigation into soil erosion and controls in Zimbabwe using ^{137}Cs is reported by Quine *et al.* in Section 5. Banzal and Hayase (Section 6) describe some nice experimental results from a special type of lysimeter and derive a new soil loss equation for sandy and volcanic ash materials. As a final example, Rose *et al.*, also in Section 6, set out an interesting theoretical basis for discriminating between mass movement and rainfall detachment/overland flow processes on hillslopes.

There are other strengths. The volume acts as a useful showcase for recent Japanese research on hillslope instability and erosion processes (15 papers), which should help to balance the explosion of work from that country on channel hydraulics and river engineering. Environmental representation is good, and papers on tropical, subtropical, arid, semi-arid, humid temperate and cold regions can be found. Several new techniques are paraded. Furthermore, a wealth of soil erosion data, from plot to catchment scale, is made available through its pages. Finally, there is a refreshingly strong focus on slope processes, and particularly hillslope hydrology, in explanations and predictions of sediment yield.

However, my feeling is that this volume lacks something of the coherence and sparkle of other IAHS 'sediment' volumes (e.g. Bordas and Walling, 1988; Hadley and Ongley, 1989; Bogen *et al.*, 1992). Its great breadth works against the emergence of unifying themes or detailed research agenda. There are only two

internationally collaborative efforts represented, very few interdisciplinary contributions, and too many papers betray a lack of awareness of advances elsewhere and display a rather parochial approach to reference citation. Potentially useful datasets are presented but, occasionally, data collection methods are so briefly described as to inhibit meaningful interpretation of results; this is especially curious given the methodological flavour implied by the volume subtitle and preface. Moreover, few contributions attempt to quantify error and uncertainty or volunteer a clear and concise statement of conclusions. Furthermore, despite IAHS advice to authors, too many submissions fail to include principal conclusions in the abstract, and this may frustrate future searches of bibliographic databases (and potential users of the full paper!).

Nevertheless, the timetable for prepublished proceedings is extremely tight, and the editors should be thanked for convening the Yokohama conference, screening the contributions, and welding a somewhat disparate collection of papers into a finished volume. Despite the reservations noted above, this volume could point the way to much-needed future collaboration between those with slope process expertise—especially geotechnical, geomorphological and hydrological research groups—and channel dynamics specialists. There is much in IAHS Publication No. 217 to suggest that linking hillslope to channel more explicitly would yield substantial advances in understanding, monitoring and managing sediment problems.

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REFERENCES

- Bogen, J., Walling, D.E. and Day, T. J. (Eds). 1992. *Erosion and Sediment Transport Monitoring Programmes in River Basins, Proceedings of Oslo Symposium, August 1992*, IAHS Publication No. 210, 538 pp.
- Bordas, M. P. and Walling, D. E. (Eds). 1988. *Sediment Budgets, Proceedings of Porto Alegre Symposium, December 1988*, IAHS Publication No. 174, 591 pp.
- Hadley, R. F. and Ongley, E. D. (Eds). 1989. *Sediment and the Environment, Proceedings of Baltimore Symposium, May 1989*, IAHS Publication No. 184, 218 pp.

PHYSICAL ADJUSTMENTS IN A CHANGING LANDSCAPE: THE SINGAPORE STORY edited by A. Gupta and J. Pitts, Singapore University Press, Singapore, 1992. No. of pages: xviii + 423. Price: US \$32.00. ISBN 9971-69-172-8.

Analysis of the urban environment embraces the physical

situation of a city, the modifications of that environment by urban activity, and the hazards and problems that arise from such modifications. All three aspects are remarkably well dealt with in this excellent study of the physical geography of Singapore, which is also a noteworthy contribution to tropical geomorphology. One hundred and eight pages are devoted to the geology and geomorphic evolution of Singapore, and a further

83 pages to the applied geomorphology of reclaimed land, slope stability, and urban hydrology and sedimentation.

John Pitts' contribution on the Quaternary of Singapore deserves special attention for its clear analysis of the Quaternary stratigraphy, discussion of changing sea level, and palaeohydrology. The Older Alluvium, widespread in Singapore and the Malay peninsula, is now known to be a braided stream deposit, developed under a seasonal climate with mean annual rainfall of 1800 to 1900 mm. This seasonal climate, over the whole western part of the Sunda Shelf, suggests that some of the sandy deposits covered with poor *kerangas* forest in Borneo might have been formed in the same periods of the Quaternary under similar, seasonally wet climates. The detailed work undertaken in Singapore is thus a basis for wider investigation into the Quaternary of the equatorial lowlands of SE Asia.

The Kallang Formation, made up of marine, fluvial, littoral, coral reef and estuarine sediments, straddles a range of Late Pleistocene and Holocene environmental conditions and sea levels. Investigation of this Formation has been fostered by foundation engineering needs in Singapore in the 1980s, and despite having no surface exposures, the marine member covers 25 per cent of Singapore Island. Lowering of groundwater tables in the marine clay of the Kallang Formation can lead to large surface settlements and damage to both multi-storey and single-storey buildings, as Broms and Wong explain. Civil engineering has also assisted the study of weathering profiles and slopes in Singapore, but despite the importance of deep regoliths, there is scant mention of problems associated with colluvium overlying weathered rock *in situ*. The subdued relief of Singapore may mean that few such problems occur, but slope instability sometimes arises in colluvial materials.

Pitts reviews the literature on slopes, coastal

geomorphology, and erosion processes. Periods of slope instability occur after sufficient quantities of rain prior to failure have raised the water content of near-surface slope materials. A one-day rainfall of sufficient magnitude then has to occur to trigger failure. The precise volumes of five- and one-day rainfall which lead to landslide events are not fully known. Failures which occur in fill slopes on construction sites are among the largest landslides in Singapore. One at Bukit Gombak involved the movement of 50 000 m³ of material and badly damaged several houses. The techniques for managing water to achieve stable fill slopes need constant attention, as the collapse of a block of flats in nearby Kuala Lumpur in December 1993 tragically demonstrated.

Gupta's chapter on floods and sedimentation provides the best indication of the geomorphic consequences of Singapore's expanding urbanization. The widening of the upper part of the main Bukit Timah Canal from a 16 m trapezoidal drain to a 20–26 m U-drain indicates the magnitude of works needed to cope with urban runoff. Singapore has had to divert waters from the Bukit Timah Canal under a hill into a different catchment to avoid increasing the flood risk in the city centre. Ausafur Rahman provides some valuable data on soil mechanical and hydrological properties, finding, as do many others in SE Asia, that hydraulic conductivities are high near the surface but decrease below 10 cm. Only 2 per cent of throughfall becomes overland flow or shallow underflow in dry months and about 8 per cent in wet months. Although much useful local information is to be found in this book, this review suggests that it is in some ways more valuable as a piece of applied geomorphology than as a complete urban environmental analysis of a particular city.

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ROUGH WATER MAN: ELWYN BLAKE'S COLORADO RIVER EXPEDITIONS by R. E. Westwood, University of Nevada Press, Reno, Nevada, 1992. No. of pages: xxi + 259. Price: £25.00. ISBN 0-87417-188-1.

Rough Water Man provides a unique chronicle of the surveys of the deep canyons of the Colorado River which took place between 1921 and 1923 under the auspices of the USGS. Based on original field notes, in particular the diaries of Elwyn Blake (a junior member of several expeditions) and written by his nephew, the book offers an essentially personal, and frequently very intense, perspective of the exploitation of the Colorado River waters. It is a book which works well at a variety of levels, detailing the various river expeditions,

evaluating their importance in the development of the Colorado basin, and discussing the environmental and other issues surrounding the use of the river today.

The majority of the book forms a rites of passage narrative, beginning with Elwyn working as a printer's apprentice, his application to join the surveys, and charting his subsequent rise from staffman and cook's assistant to his eventual position as fully fledged boatman (a true rough water man). Here, the book is at its best, capturing the majesty of the landscape, the power of the river and the wonder of those privileged enough to be passing through it. There are also some revealing insights into the personal dynamics of the survey party, with its rigid social and scientific hierarchy and the differing responses to the highly routinized (but often life-threatening) task of surveying the line.

The later sections of the book see a 70-year-old Elwyn